US009472913B1

(12) **United States Patent**
Mizrahi

(10) **Patent No.: US 9,472,913 B1**
(45) **Date of Patent: Oct. 18, 2016**

(54) **POWER ADAPTER WITH A CABLE RETENTION STRUCTURE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/731,184**

(22) Filed: **Jun. 4, 2015**

Related U.S. Application Data

(60) Provisional application No. 62/165,999, filed on May 24, 2015.

(51) **Int. Cl.**
H01R 31/06 (2006.01)
H01R 27/02 (2006.01)
H01R 13/72 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 31/06*** (2013.01); ***H01R 13/72*** (2013.01); ***H01R 27/02*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 13/6275; H01R 13/6392; H01R 31/06; H01R 13/627; H01R 13/6271; H01R 13/6272
See application file for complete search history.

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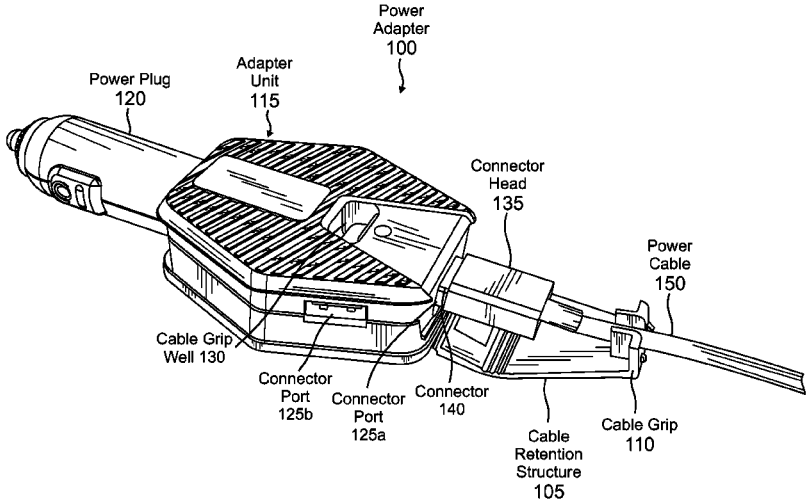
(57) **ABSTRACT**

A power adapter includes a power plug and a connector port. A cable retention structure is coupled to the power adapter to move between an open position and a closed position. In an open position, a cable grip of the cable retention structure is configured to hold a power cable, e.g. when the power cable is coupled to the connector port. The cable grip cable holds the power cable to help resist disconnection of the power cable from the connector port. In a closed position, the cable retention structure moves to fold over a side of the power adapter. The cable grip of the cable retention structure fits into a cable grip well in the side of the power adapter and is frictionally held within the cable grip well to secure the cable retention structure in the closed position.

16 Claims, 14 Drawing Sheets



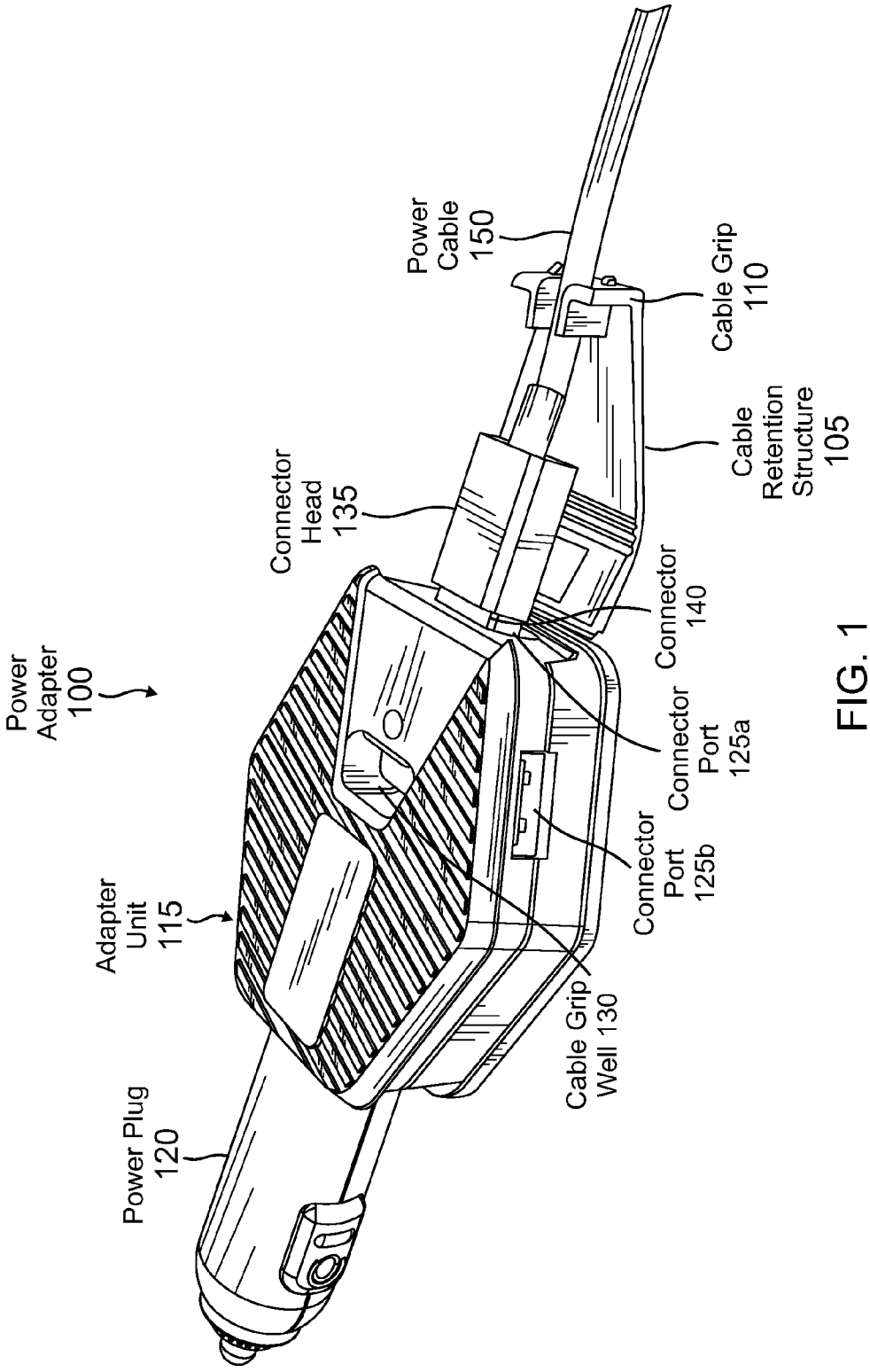

Power Adapter 100
Adapter Unit 115
Power Plug 120
Power Cable 150
Cable Grip 110
Cable Retention Structure 105
Connector Head 135
Connector 140
Connector Port 125a
Connector Port 125b
Cable Grip Well 130

FIG. 1

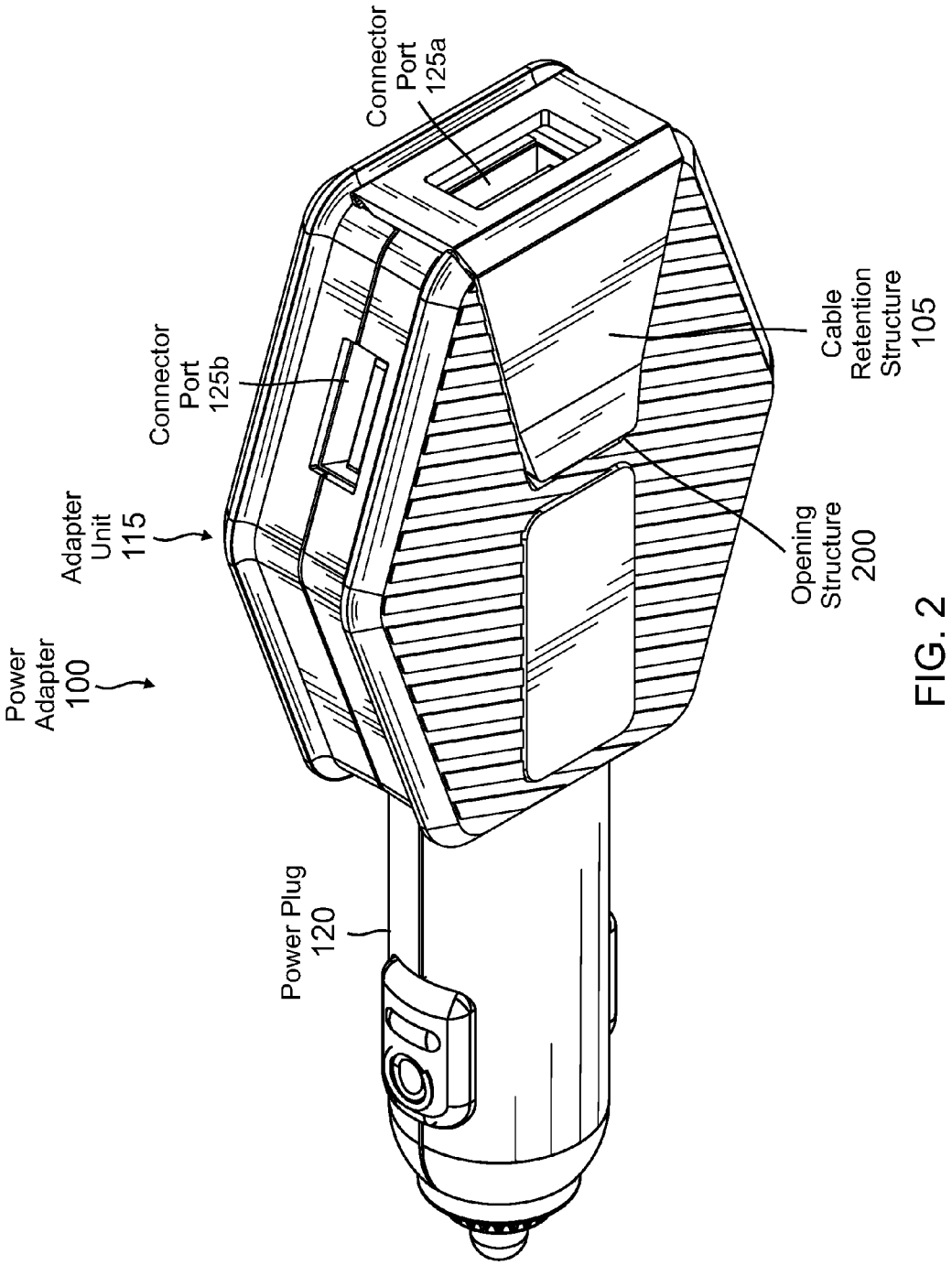

Power Adapter 100
Adapter Unit 115
Connector Port 125b
Connector Port 125a
Cable Retention Structure 105
Opening Structure 200
Power Plug 120

FIG. 2

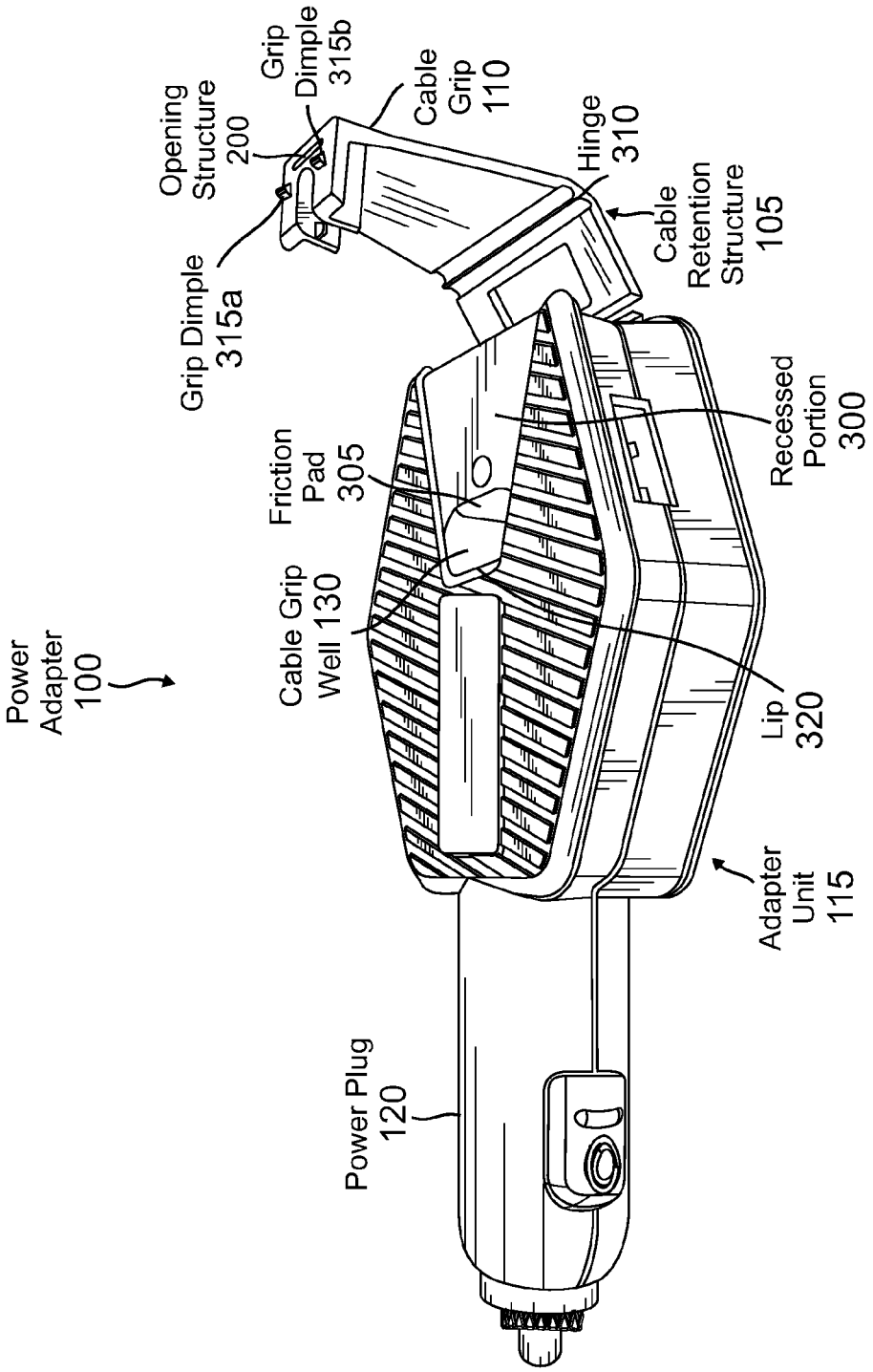

Power Adapter 100
Opening Structure 200
Grip Dimple 315b
Cable Grip 110
Hinge 310
Cable Retention Structure 105
Grip Dimple 315a
Recessed Portion 300
Friction Pad 305
Cable Grip Well 130
Lip 320
Adapter Unit 115
Power Plug 120

FIG. 3

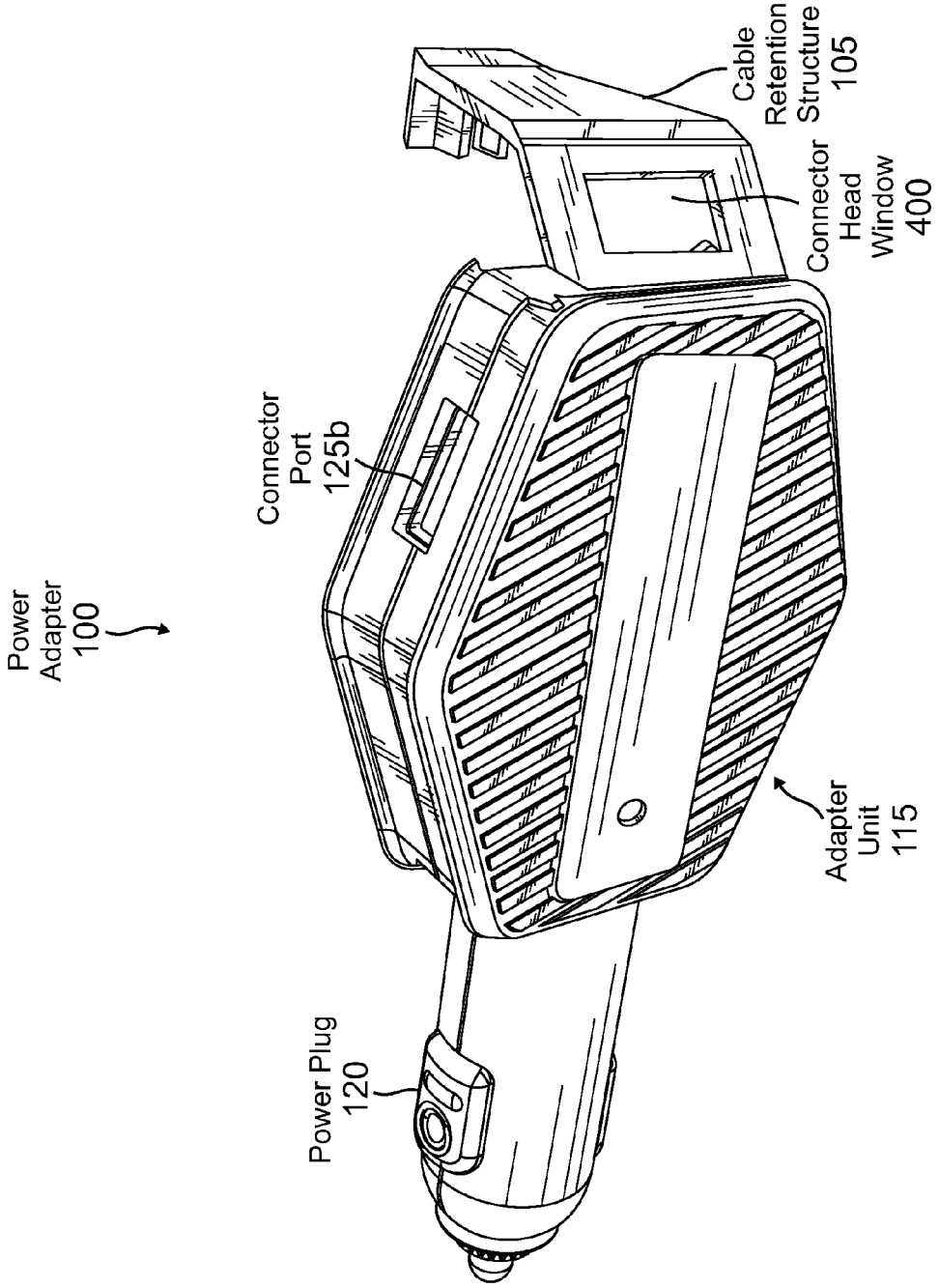

Power Adapter 100
Connector Port 125b
Cable Retention Structure 105
Connector Head Window 400
Adapter Unit 115
Power Plug 120

FIG. 4

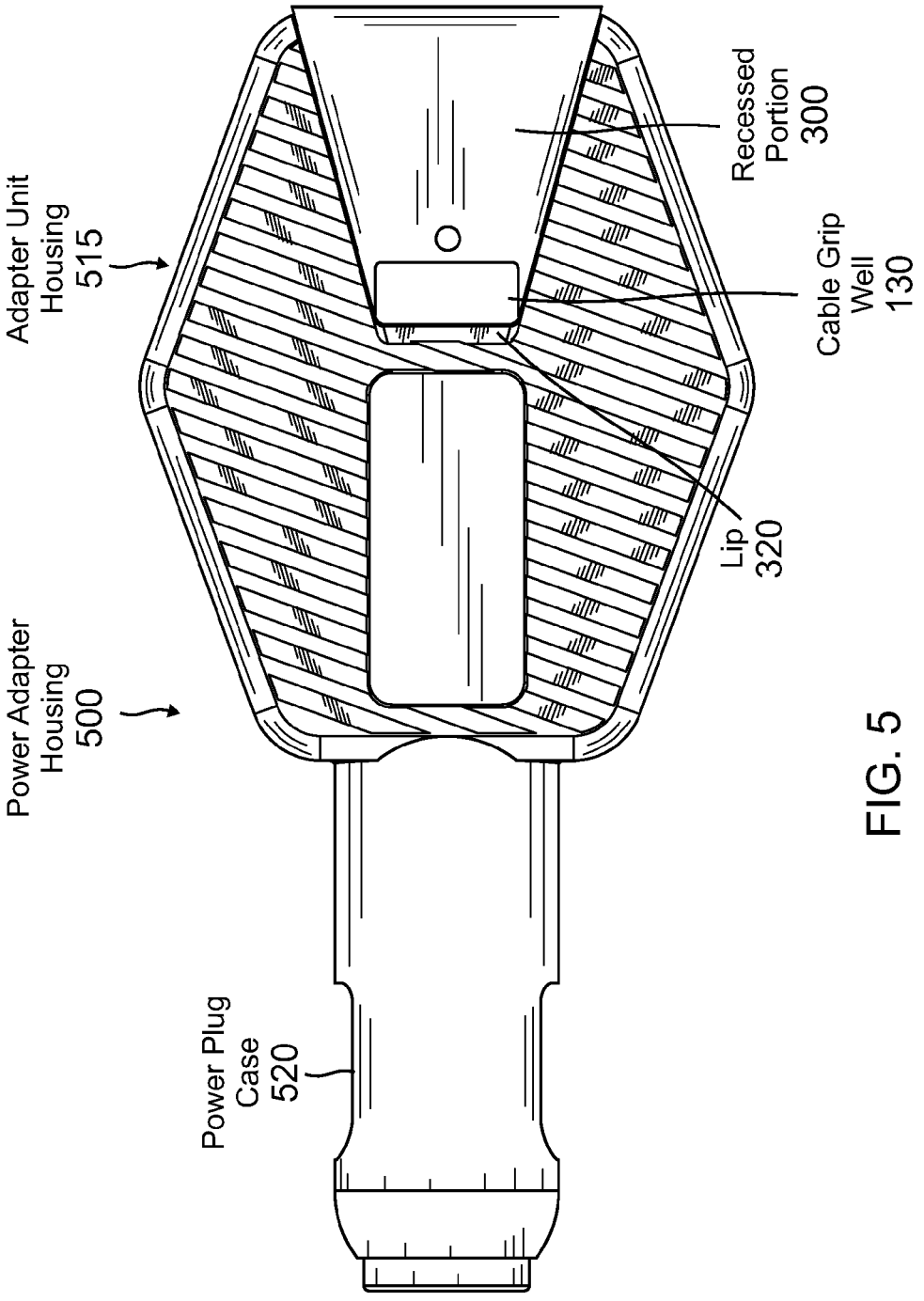

Adapter Unit Housing 515
Power Adapter Housing 500
Power Plug Case 520
Recessed Portion 300
Cable Grip Well 130
Lip 320

FIG. 5

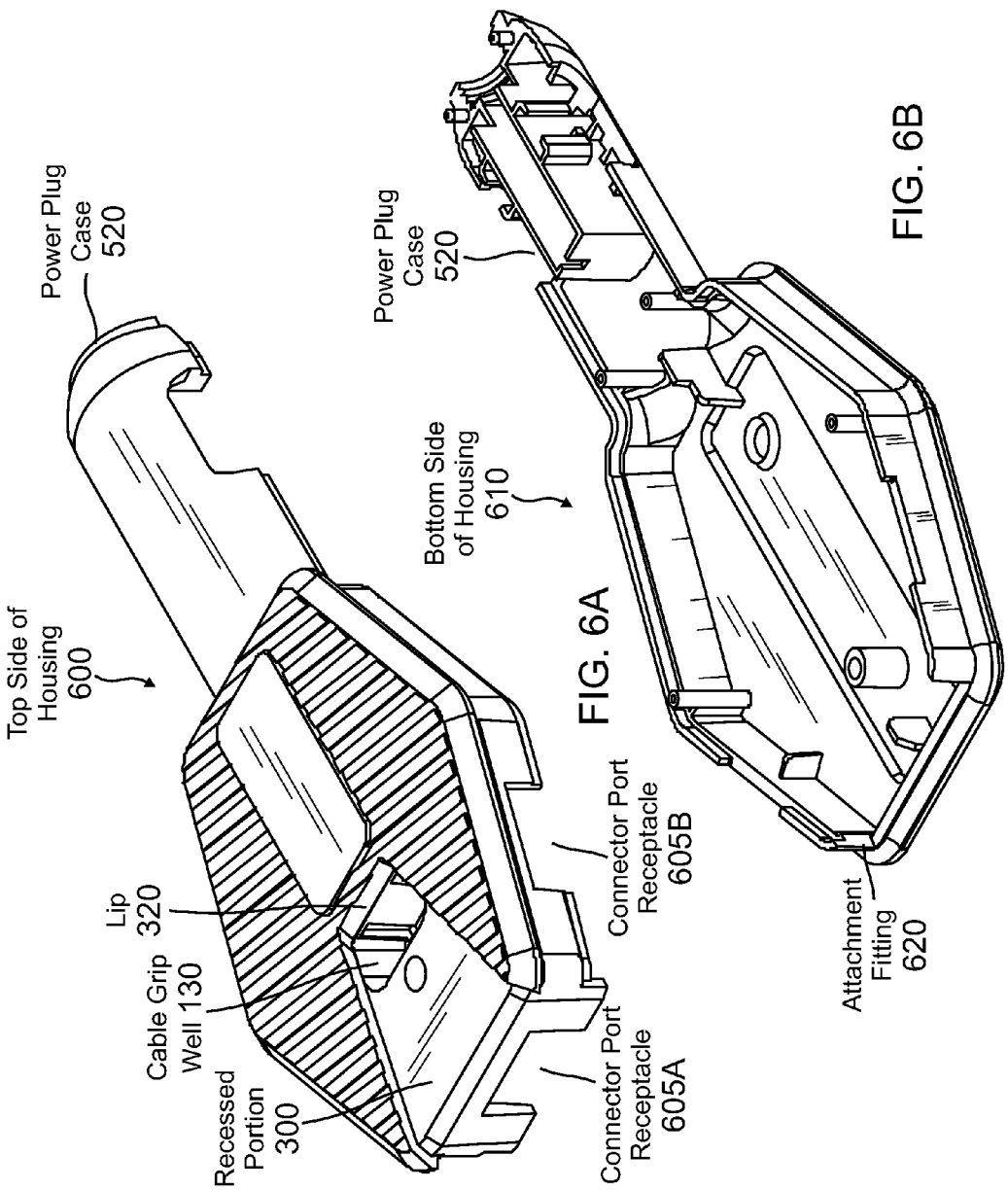

Power Plug Case 520
Top Side of Housing 600
Lip 320
Cable Grip Well 130
Recessed Portion 300
Connector Port Receptacle 605A
Connector Port Receptacle 605B
Power Plug Case 520
Bottom Side of Housing 610
Attachment Fitting 620

FIG. 6A

FIG. 6B

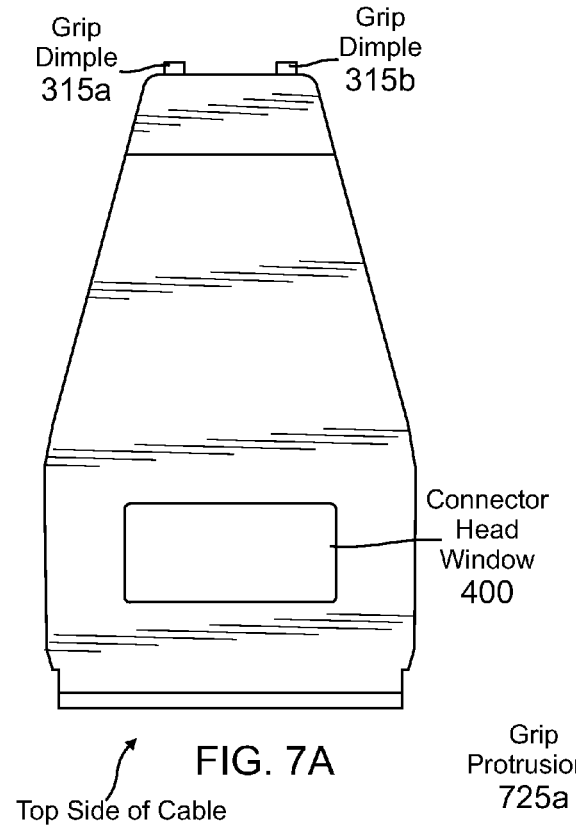

Grip Dimple 315a
Grip Dimple 315b
Connector Head Window 400
Top Side of Cable Retention Structure 700

FIG. 7A

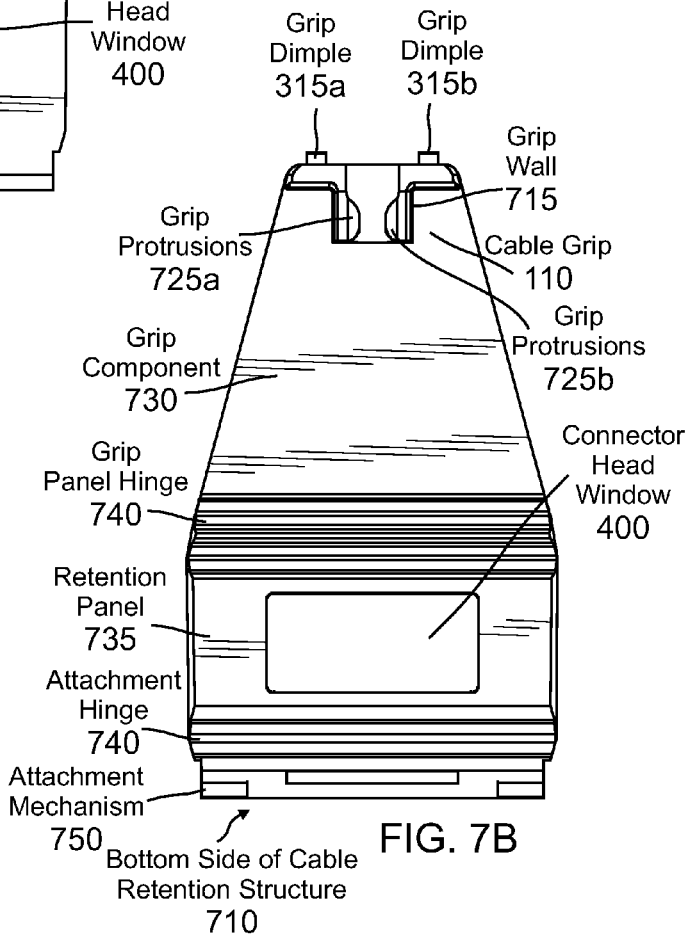

Grip Dimple 315a
Grip Dimple 315b
Grip Wall 715
Grip Protrusions 725a
Cable Grip 110
Grip Protrusions 725b
Grip Component 730
Connector Head Window 400
Grip Panel Hinge 740
Retention Panel 735
Attachment Hinge 740
Attachment Mechanism 750
Bottom Side of Cable Retention Structure 710

FIG. 7B

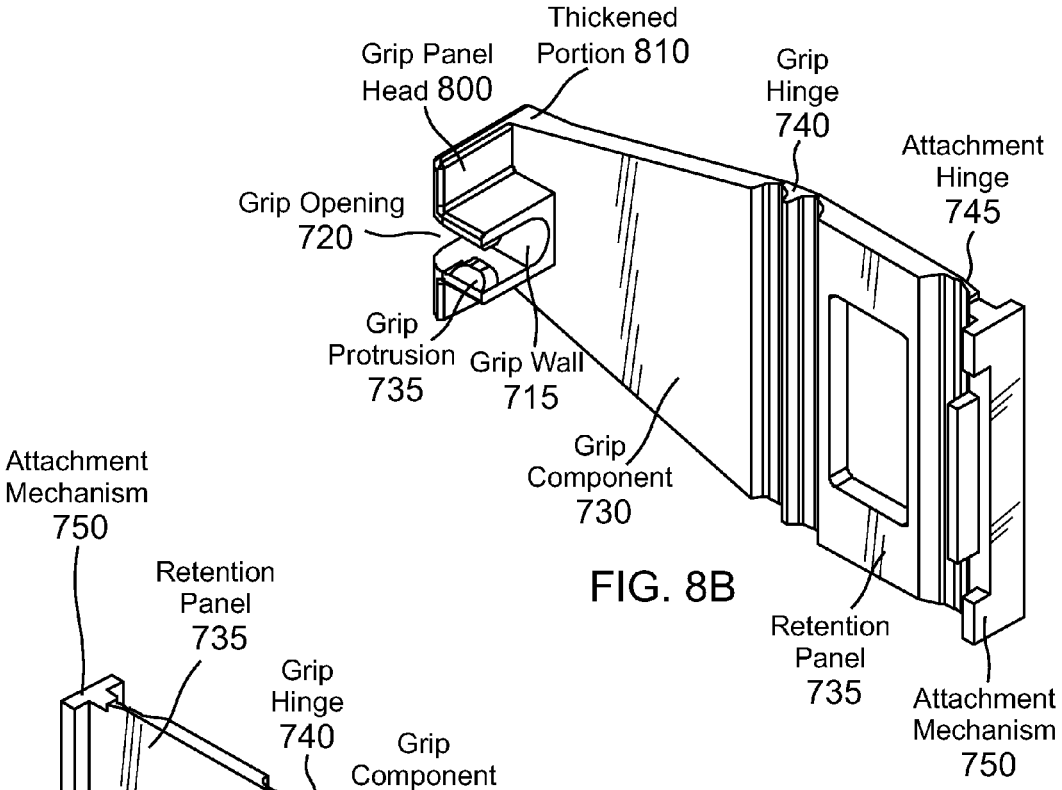

Thickened
Portion 810
Grip Panel
Head 800
Grip
Hinge
740
Attachment
Hinge
745
Grip Opening
720
Grip
Protrusion
735
Grip Wall
715
Grip
Component
730
Attachment
Mechanism
750
Retention
Panel
735
Retention
Panel
735
Attachment
Mechanism
750

FIG. 8B

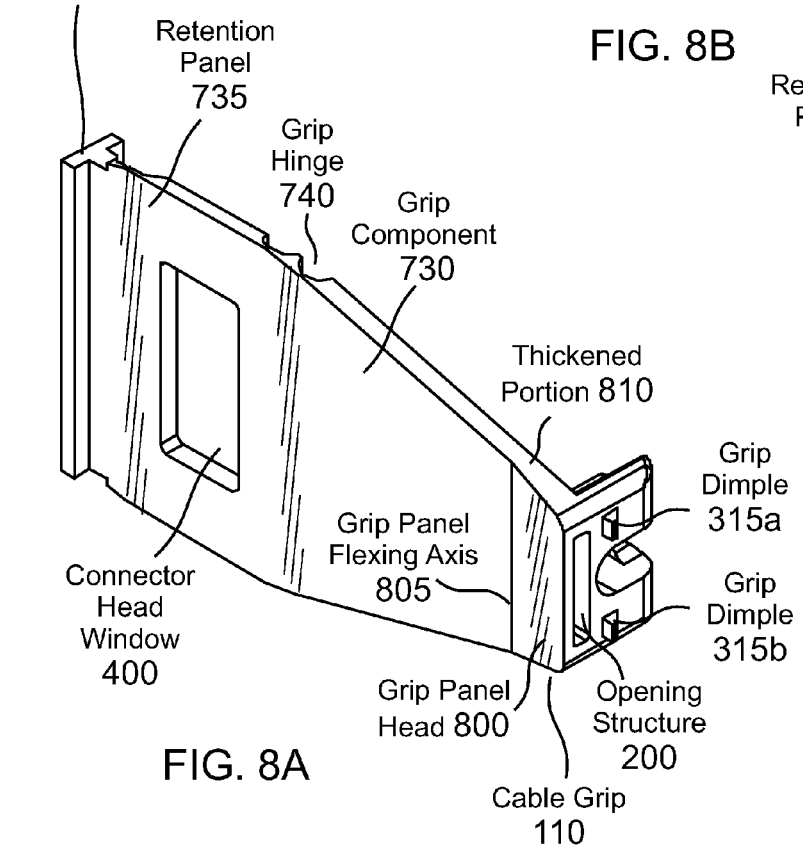

Retention
Panel
735
Grip
Hinge
740
Grip
Component
730
Thickened
Portion 810
Grip
Dimple
315a
Grip Panel
Flexing Axis
805
Grip
Dimple
315b
Connector
Head
Window
400
Grip Panel
Head 800
Opening
Structure
200
Cable Grip
110

FIG. 8A

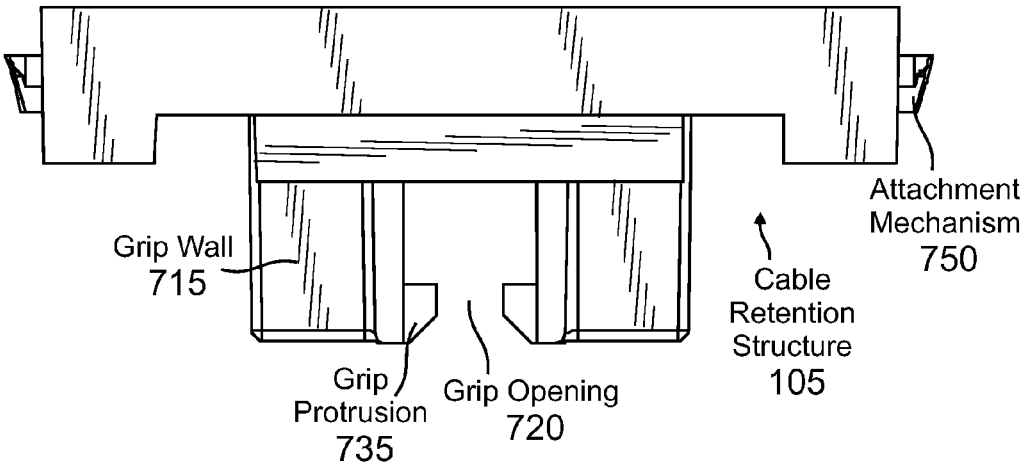

Attachment Mechanism 750
Grip Wall 715
Cable Retention Structure 105
Grip Protrusion 735
Grip Opening 720

FIG. 9A

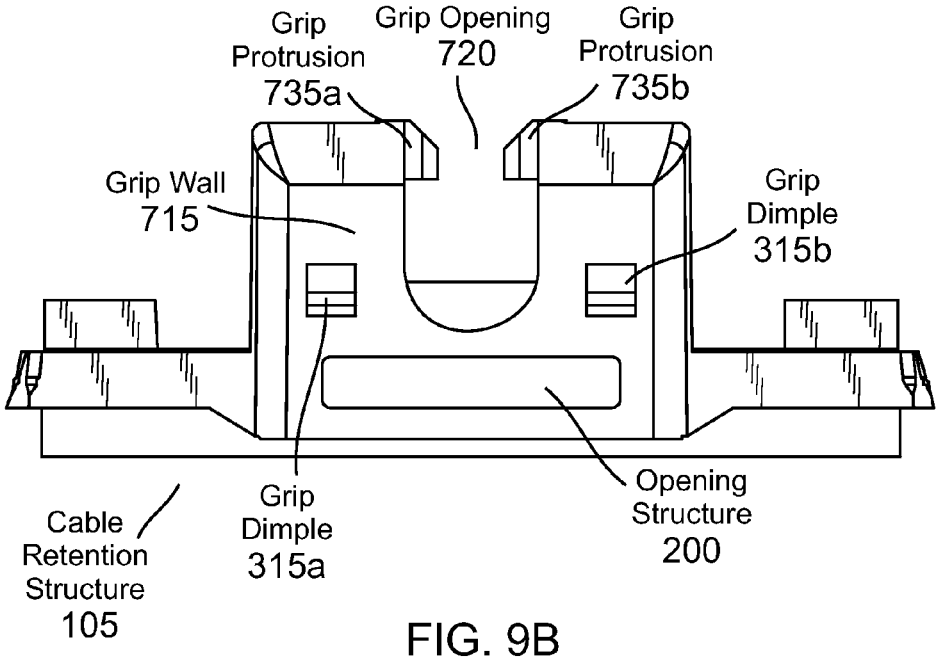

Grip Protrusion 735a
Grip Opening 720
Grip Protrusion 735b
Grip Wall 715
Grip Dimple 315b
Cable Retention Structure 105
Grip Dimple 315a
Opening Structure 200

FIG. 9B

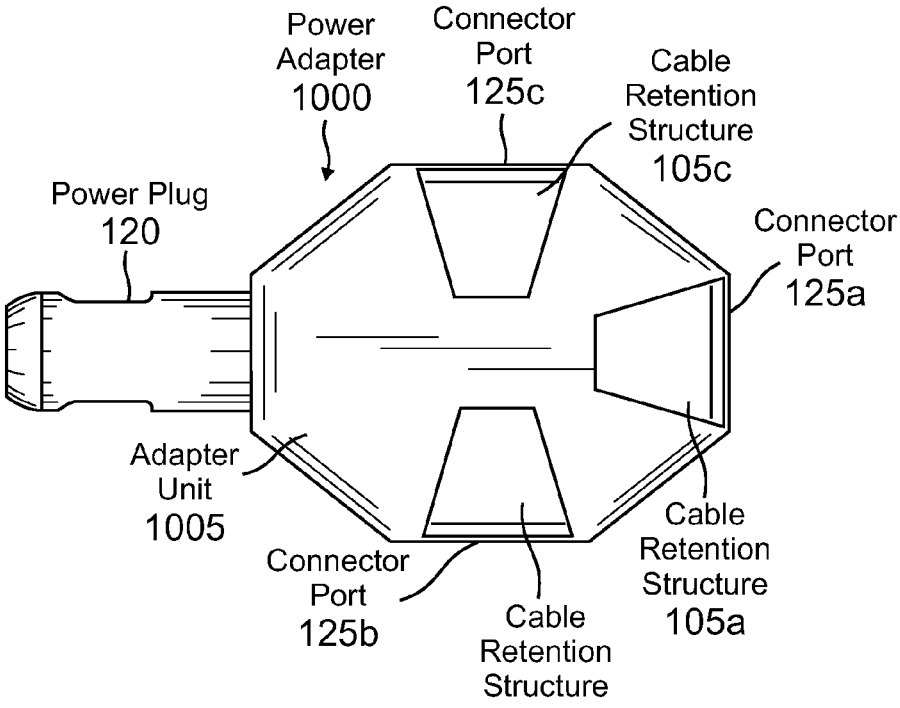

Power Adapter 1000
Connector Port 125c
Cable Retention Structure 105c
Power Plug 120
Connector Port 125a
Adapter Unit 1005
Connector Port 125b
Cable Retention Structure 105a
Cable Retention Structure 105b

FIG. 10

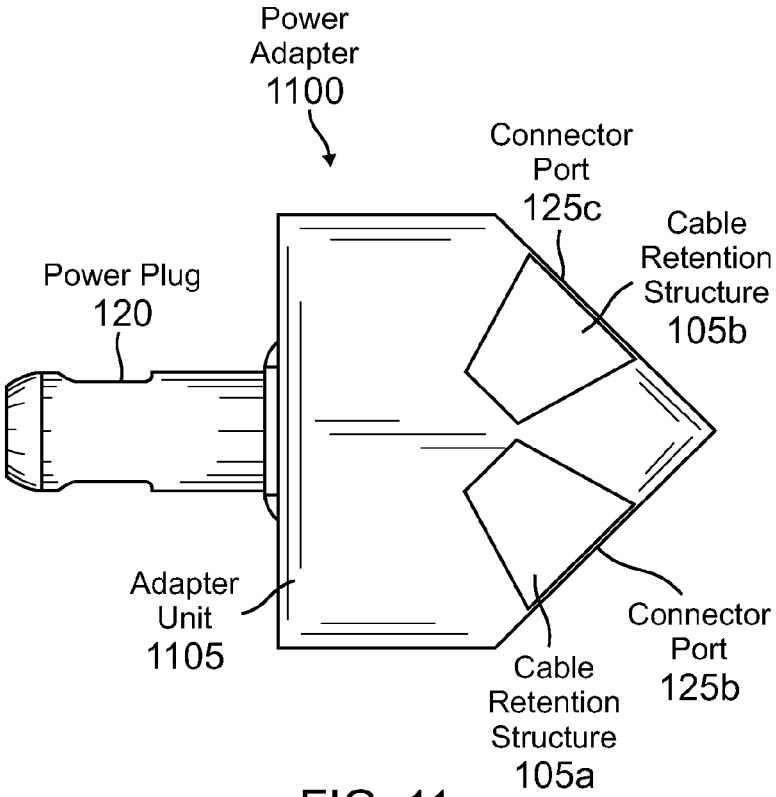

Power Adapter 1100
Connector Port 125c
Cable Retention Structure 105b
Power Plug 120
Adapter Unit 1105
Connector Port 125b
Cable Retention Structure 105a

FIG. 11

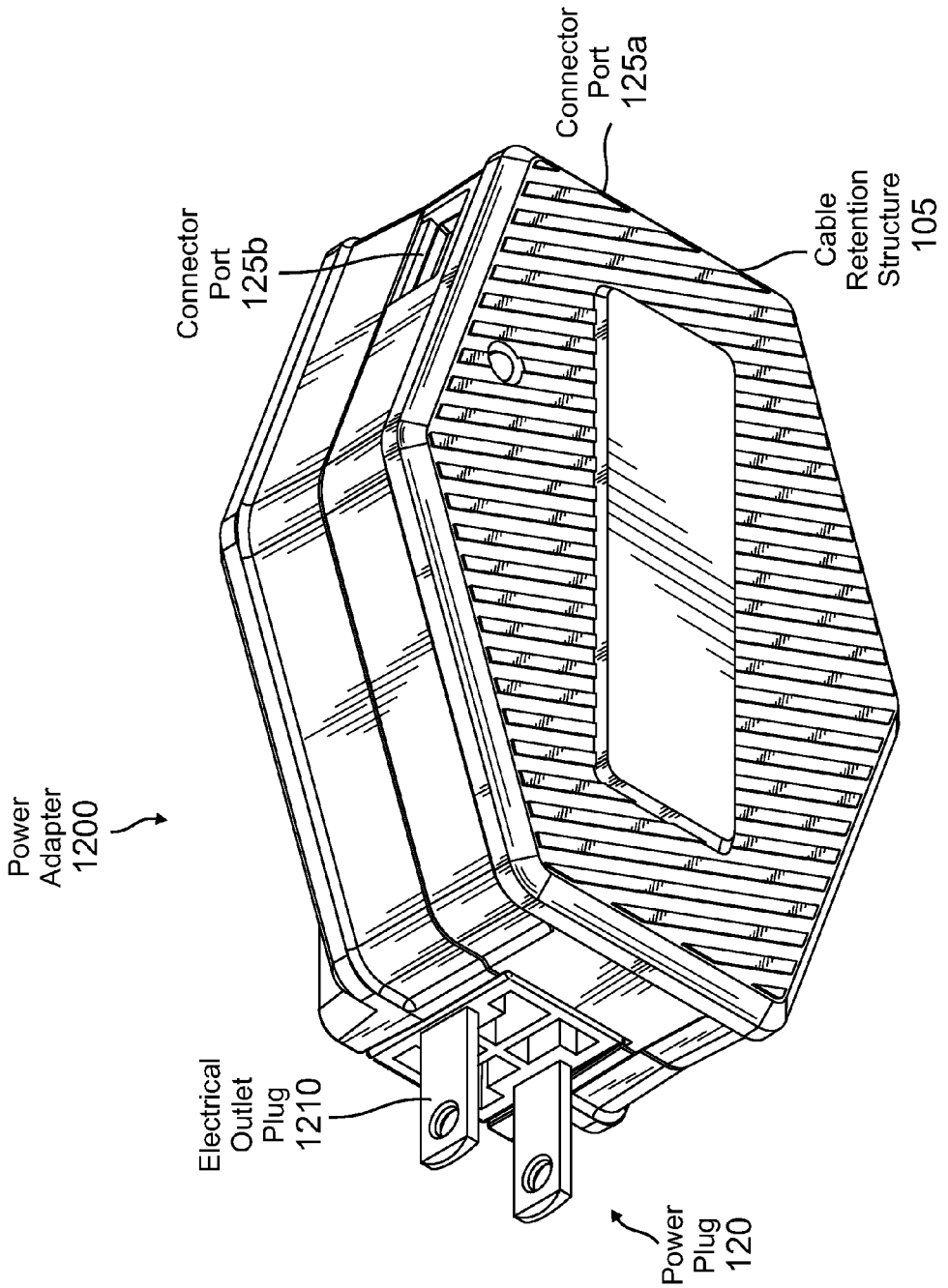

Power Adapter 1200
Connector Port 125b
Connector Port 125a
Cable Retention Structure 105
Electrical Outlet Plug 1210
Power Plug 120

FIG. 12

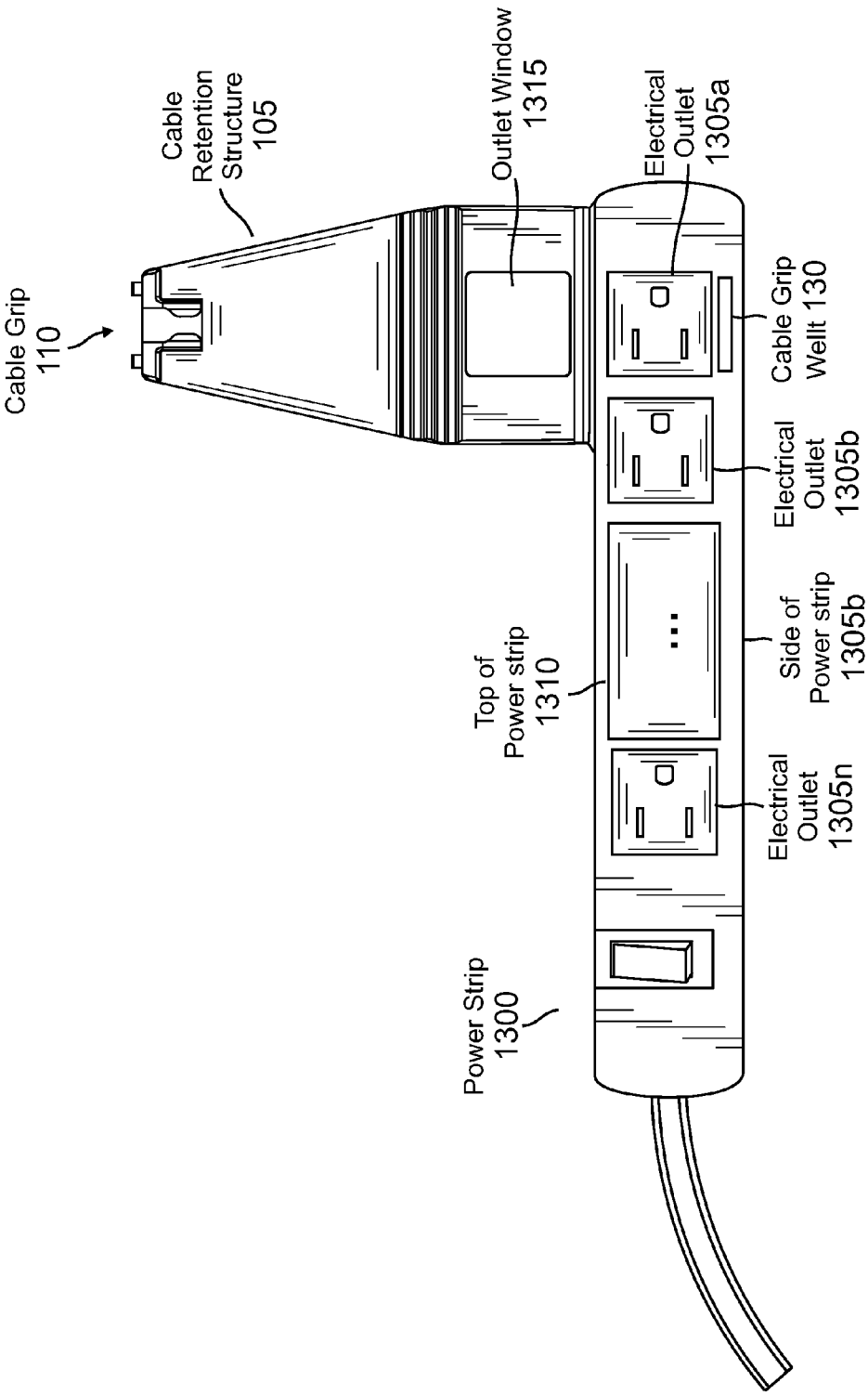

Cable Grip 110
Cable Retention Structure 105
Outlet Window 1315
Electrical Outlet 1305a
Cable Grip Wellt 130
Electrical Outlet 1305b
Side of Power strip 1305b
Top of Power strip 1310
Electrical Outlet 1305n
Power Strip 1300

FIG. 13

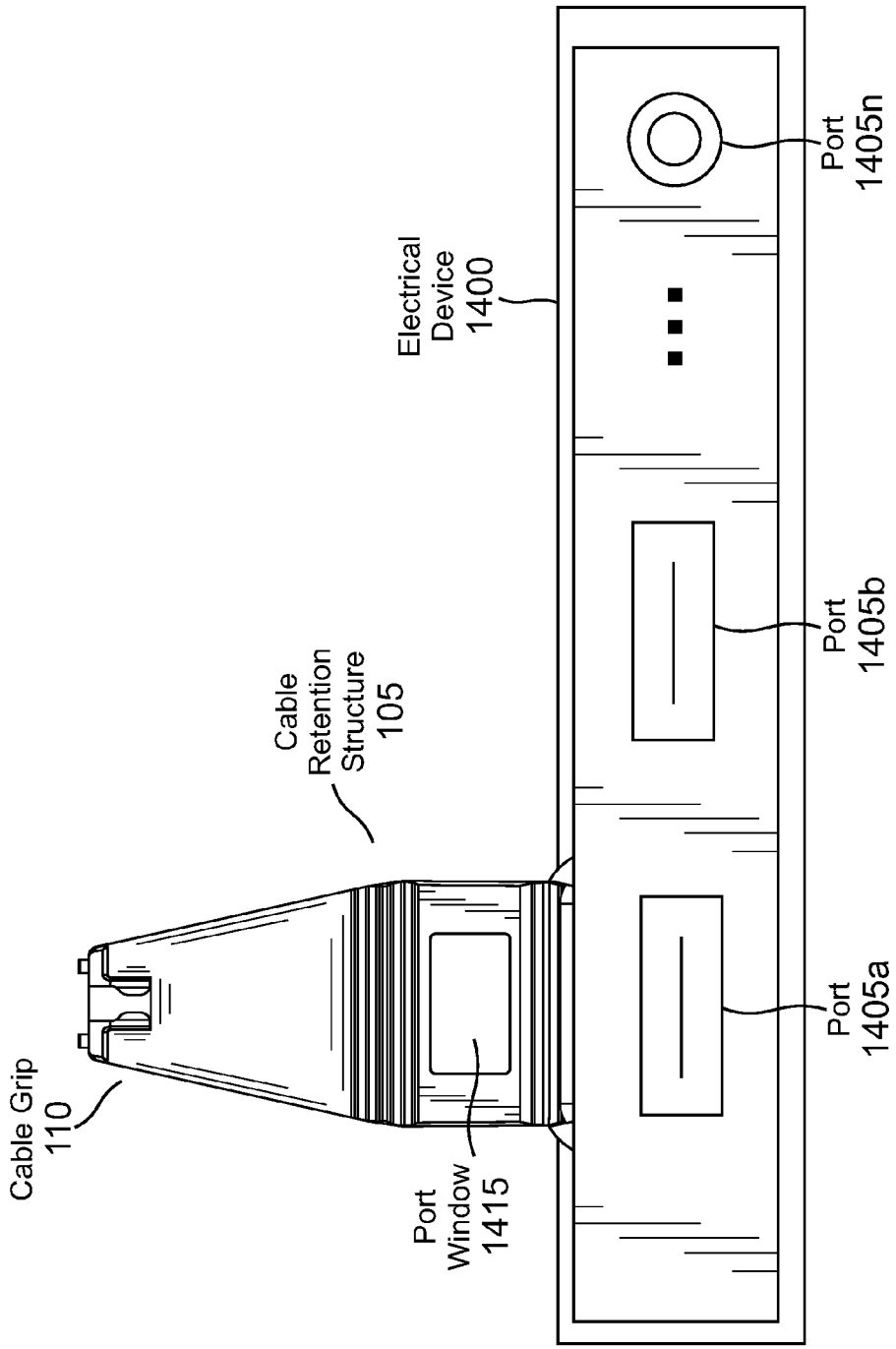

Cable Grip
110
Port Window
1415
Cable Retention Structure
105
Electrical Device
1400
Port
1405a
Port
1405b
Port
1405n

FIG. 14

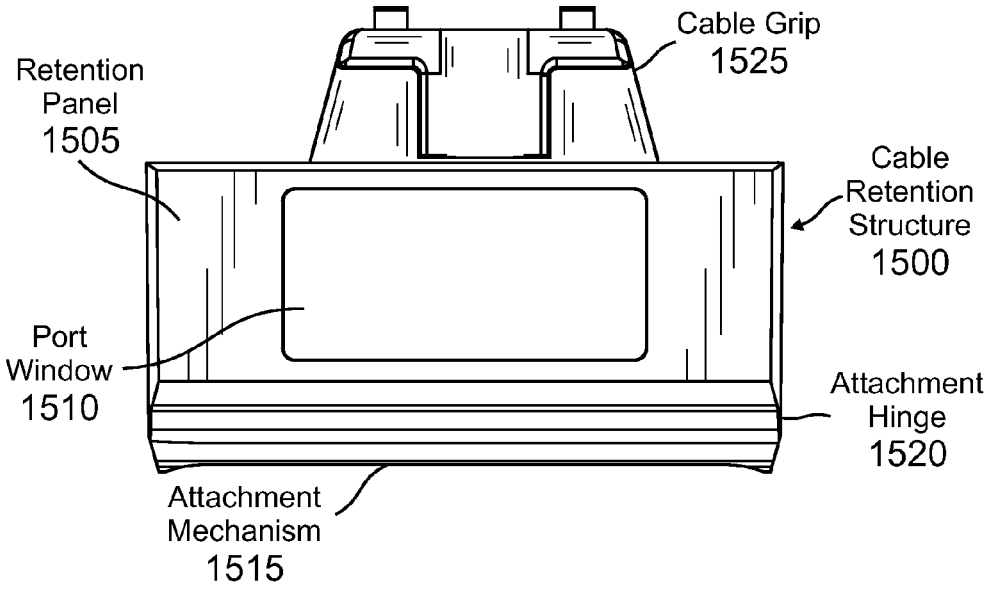

Cable Grip
1525
Retention
Panel
1505
Cable
Retention
Structure
1500
Port
Window
1510
Attachment
Hinge
1520
Attachment
Mechanism
1515

FIG. 15

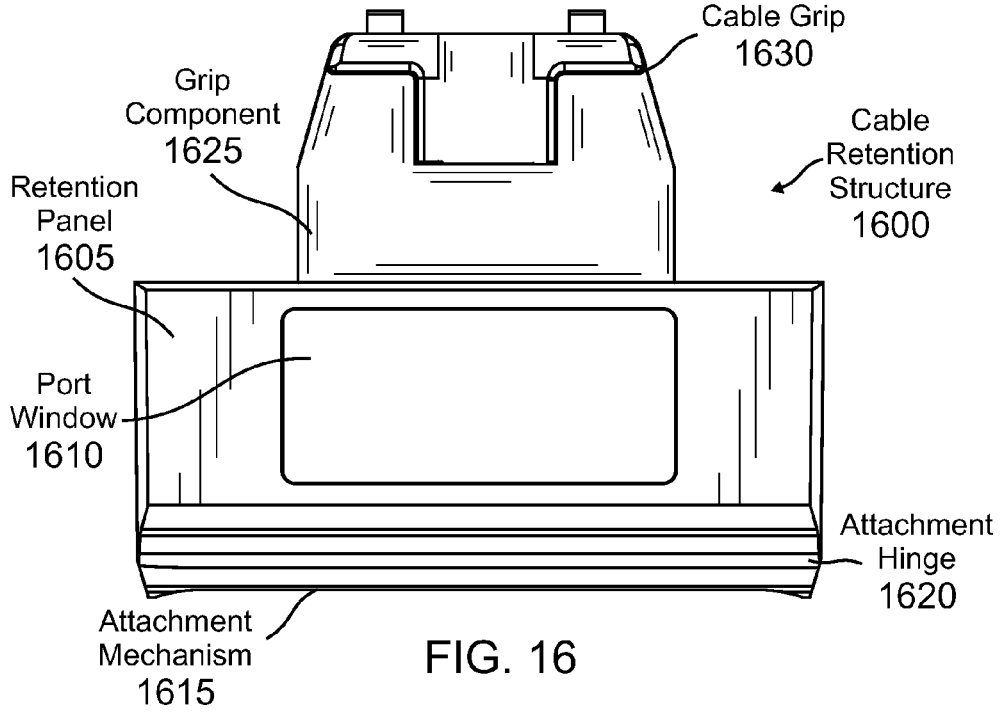

Cable Grip
1630
Grip
Component
1625
Cable
Retention
Structure
1600
Retention
Panel
1605
Port
Window
1610
Attachment
Hinge
1620
Attachment
Mechanism
1615

FIG. 16

POWER ADAPTER WITH A CABLE RETENTION STRUCTURE

TECHNICAL FIELD

The present disclosure relates generally to power adapters, and more particularly, to power adapters with a cable retention structure.

BACKGROUND

A power adapter is used with an electrical device to derive a required voltage or current from a main power supply. A power adapter may be used with an electrical device with no other source of power or with a battery-powered device to charge a battery. A power adapter may include, e.g. an AC adapter, AC/DC adapter, or AC/DC converter. The power adapter thus enables an electrical device to obtain power from a variety of different types of external power supplies, such as a 120V AC supply, 230V AC main supply, a battery, etc.

One type of power adapter includes a cigarette lighter adapter. A cigarette lighter adapter generally includes a power plug that connects to a cigarette lighter socket for providing power from a vehicle battery. The cigarette lighter adapter may also include a USB port that connects to a power cable to provide power to an electrical device in the vehicle. For example, when a device runs low or out of power, a power cable with a USB connector may be coupled to the USB port of the power adapter and to the external device. The cigarette lighter power plug of the power adapter is then plugged into the cigarette lighter socket. Power may then be transferred from the vehicle battery to the power adapter and then through the power cable to the electrical device.

One or more improvements to embodiments of a power adapter are described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of the apparatus and/or methods in accordance with embodiments of the disclosure are now described, by way of example only, and with reference to the accompanying drawings, in which like reference numerals identify similar components throughout:

FIG. **1** illustrates a schematic diagram of an embodiment of a power adapter with a cable retention structure with an attached power cable.

FIG. **2** illustrates a schematic diagram of an embodiment of a power adapter with a cable retention structure in a closed position.

FIG. **3** illustrates a perspective bottom view of a schematic diagram of an embodiment of the power adapter with the cable retention structure in an open position.

FIG. **4** illustrates a perspective top view of a schematic diagram of an embodiment of the power adapter with the cable retention structure in an open position.

FIG. **5** illustrates a top view of a schematic diagram of an embodiment of a power adapter housing.

FIG. **6**A illustrates a perspective view of the top side of the housing for the power adapter of FIG. **5**.

FIG. **6**B illustrates a perspective view of the bottom side of the housing for the power adapter charger of FIG. **5**.

FIG. **7**A illustrates a schematic diagram of an embodiment of a top view of a cable retention structure.

FIG. **7**B illustrates a schematic diagram of an embodiment of a bottom view of the cable retention structure of FIG. **7**A.

FIG. **8**A illustrates a perspective top view of an embodiment of the cable retention structure.

FIG. **8**B illustrates a perspective bottom view of an embodiment of the cable retention structure of FIG. **8**A.

FIG. **9**A illustrates a schematic diagram of an embodiment of a first end of the cable retention structure of FIG. **6**A.

FIG. **9**B illustrates a schematic diagram of an embodiment of a second end of the cable retention structure of FIG. **6**A.

FIG. **10** illustrates a schematic diagram of another embodiment of a power adapter with a cable retention structure.

FIG. **11** illustrates a schematic diagram of another embodiment of a power adapter with a cable retention structure.

FIG. **12** illustrates a schematic diagram of another embodiment of a power adapter with a cable retention structure.

FIG. **13** illustrates a schematic diagram of an embodiment of a power strip with a cable retention structure.

FIG. **14** illustrates a schematic diagram of an embodiment of an electrical device with a cable retention structure.

FIG. **15** illustrates a schematic diagram of another embodiment of a cable retention structure.

FIG. **16** illustrates a schematic diagram of another embodiment of a cable retention structure.

SUMMARY

The following presents a simplified summary in order to provide a basic understanding of some embodiments. This summary is not an extensive overview and is not intended to identify key or essential elements or delineate the scope of the embodiments herein.

According to one aspect, a power adapter includes an adapter unit including a power plug mounted to a first side of the adapter unit and a connector port in a second side of the adapter unit, wherein the connector port is configured for coupling to a connector head of a power cable. A cable retention structure is attached to the adapter unit, wherein the cable retention structure includes a cable grip configured to hold the power cable.

In another aspect, the cable retention structure comprises an attachment mechanism that attaches the cable retention structure to the adapter unit such that the cable retention structure is operable to move between an open position and a closed position.

In another aspect, a window is formed within the cable retention structure that overlaps the connector port when the cable retention structure is in a closed position.

In another aspect, the cable grip comprises at least one grip wall that forms a u-shaped grip opening. At least one grip protrusion protrudes from the grip wall and projects into the grip opening. The at least one grip protrusion is configured for frictionally clasping the power cable when the cable retention structure is in the open position.

In another aspect, the cable retention structure further comprises a grip component coupled to the cable grip and a grip hinge coupled between the grip component and the attachment mechanism. The grip hinge is configured to fold the grip component across an exterior side of the adapter unit when the cable retention structure is in the closed position.

In another aspect, a cable grip well is formed within an exterior side of the adapter unit, wherein the cable grip well is configured to hold the cable grip when the cable retention structure is in the closed position.

DETAILED DESCRIPTION

In the following detailed description, only certain exemplary embodiments of the present invention are shown and described, by way of illustration. As those skilled in the art would recognize, the invention may be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. The description and drawings merely illustrate the principles of various embodiments. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles herein and in the claims and fall within the spirit and scope of the disclosure. Furthermore, all examples recited herein are principally intended expressly to be only for pedagogical purposes to aid the reader in understanding the principles of the embodiments, and are to be construed as being without limitation to such specifically recited examples and conditions. Moreover, all statements herein reciting principles, aspects, and embodiments, as well as specific examples thereof, are intended to encompass equivalents thereof.

In the context of the present specification, when an element is referred to as being "on" another element, it can be directly on the other element or be indirectly on the other element with one or more intervening elements interposed therebetween. Also, in the context of the present specification, when an element is referred to as being "connected" or "coupled" or "attached" to another element, it can be directly connected or coupled or attached to the other element or be indirectly connected or coupled or attached to the other element with one or more intervening elements interposed therebetween.

In the following description, certain terminology is used to describe certain features of one or more embodiments. The term "opening" or "window" or "well" may refer to any opening formed in a structure and/or component or a hollowed-out place in a structure and/or component, including apertures, bores, cavities, chambers, grooves, notches, passages, recesses, slits, wells and slots. The term "protrusion" may refer to a detent, a catch, or any other suitable object or part projecting in an outward or upward manner from a structure and/or component. The term "attachment mechanism" may refer to a hook, clasp, carabiner, hinge, fastener, or any other type of device or method that may be used for attaching items together.

Overview

A problem sometimes occurs involving the connection of a power cable to a USB port of a power adapter. When the power cable is pulled, it may disconnect from the USB port. This disconnection causes the device to stop charging and leads to an inconvenience to a user. For example, a user may not notice that the power cable has been disconnected and that the device is not charged. To help prevent the disconnection of the power cable from the power adapter, embodiments are described herein of a power adapter with a cable retention structure.

In an embodiment, a power adapter includes a power plug, such as a cigarette lighter adapter plug or electrical socket plug, which is configured to connect to a power source. The power adapter also includes a connector port, such as a type of Universal Serial Bus (USB) port or other type of connector port, operable to connect to a cable, such as a power cable or cord. The power cable may be connected to an electrical device to provide power from the power adapter to the electrical device.

A cable retention structure is attached to the power adapter to move between an open position and a closed position. In an open position, a cable grip part of the cable retention structure is configured to hold the cable, e.g. when the cable is connected to the connector port. The cable grip holds the cable and helps to resist disconnection of the cable from the connector port. In a closed position, the cable retention structure folds over a side of the power adapter. The cable grip of the cable retention structure fits into a cable grip well in the side of the power adapter and is frictionally held within the cable grip well to secure the cable retention structure in the closed position.

The cable retention structure in an open position thus holds the cable to help prevent disconnection of the cable from the power adapter. The cable retention structure may also be moved to a closed position when not in use.

Exemplary Embodiments of the Power Adapter

FIG. **1** illustrates a schematic diagram of an embodiment of a power adapter **100** with a cable retention structure **105**. This example illustrates the power adapter **100** with an attached power cable **150**. The power adapter **100** includes an adapter unit **115** and a power plug **120** mounted to a first side of the adapter unit **115**. In this example, the power plug **120** is a cigarette lighter power plug configured for coupling to a cigarette lighter socket. However, other types of power plugs within the scope of this disclosure may be implemented, such as an electrical outlet plug or any other suitable type of power plug adapted to connect with a power source and supply power.

The adapter unit **115** includes at least one connector port **125***a*. The connector port **125***a* includes e.g., a type of Universal Serial Bus (USB) port, such as a USB port, mini-USB port, micro-USB port. USB is a common industry standard that defines the cables, connectors and communications protocols used for connection, communication, and power supply between devices. The connector port **125***a* may also include an IEEE 802.3af Power over Ethernet (PoE) port, a MIDI port, or other type of port operable to supply power through a cable **110** to an external device. The adapter unit **115** may also include an additional connector port **125***b*. The additional connector port **125***b* may be the same type of connector port or a different type of connector port. For example, the first connector port **125***a* may be a USB port while the second connector port **125***b* may be a mini-USB port or MIDI port. The power cable **110** includes a connector head **135** configured to house a connector **140**. The connector **140** is shaped to fit into one of the connector ports **125***a*, **125***b*.

In an embodiment, the adapter unit **115** may also include a transformer to convert the main power supply (such as the vehicle battery) from a higher voltage to a lower voltage. In some embodiments, the adapter unit **115** may also include an AC to DC converter to convert an AC main power supply to a DC power. For example, the AC to DC converter includes a rectifier circuit (such as a bridge rectifier) to convert the AC to a DC power supply and a filter to smooth the DC waveform. The adapter unit may also include other components not shown herein.

The adapter unit **115** also includes a cable retention structure **105** attached near at least one of the connector ports **125**, such as connector port **125***a* in the example of FIG. **1**. In one or more embodiments, the cable retention structure **105** is moveably attached to the adapter unit **115** to

pivot, swivel, flip, fold, rotate, slide or otherwise move between an open position and a closed position. For example, in this embodiment, the cable retention structure **105** is attached by a hinge to pivot, rotate or flip between an open position and a closed position. In other embodiments, the cable retention structure **105** may be attached with tracks to the adapter unit **115** and may slide between an open position and a closed position.

A cable grip **110** is mounted to the cable retention structure **105**. The cable grip **110** is configured to hold the attached power cable **150** when the cable retention structure is in an open position. A cable grip well **130** is formed within an exterior side of the adapter unit **115** and configured to frictionally clasp or hold the cable grip **110** when the cable retention structure **105** is in a closed position.

In use, the cable retention structure is moved from a closed position to an open position. The connector **140** of the power cable **110** is inserted into the connector port **125***a*, and the power cable **110** is inserted into the cable grip **110**. The cable grip **110** holds the power cable **110** to resist the disconnection of the connector **140** from the connector port **125***a*. The cable grip **110** may frictionally clasp the power cable **110** or assert pressure to grip the power cable **110** or a combination thereof.

FIG. **2** illustrates a schematic diagram of an embodiment of the power adapter **100** with the cable retention structure **105** in a closed position. In a closed position, the cable retention structure **105** is folded over a side of the adapter unit **115**. The cable grip **110** fits at least partially or fully within the cable grip well **130**.

To open, an end of the cable retention structure **105** forms an opening structure **200**. The opening structure **200** provides a mechanism to assist in removing or releasing the cable grip **110** from the cable grip well **130**. In an embodiment, the opening structure **200** is a slot formed in the end of the cable grip **110** that protrudes from the cable grip well **130** when the cable retention structure is in a closed position. In use, leverage is applied to the slot to lift the cable grip **110** from the cable grip well **130**. Other types of opening structures **200** may also be employed alternatively or in addition to the slot, such as a tab or grip or handle.

In the embodiments shown, the adapter unit **115** has an approximately hexagonal shape though other shapes may be implemented as described in more detail herein. A connector port **125** is formed within at least one side of the hexagonally shaped adapter unit **115**. In other embodiments, a connector port **125** is implemented in a plurality of sides of the hexagonally shaped adapter unit **115**. In yet other embodiments, a plurality of connector ports **125** may implemented in on one side of the hexagonally shaped adapter unit **115**.

FIG. **3** illustrates a perspective bottom view of a schematic diagram of an embodiment of the power adapter **100** with the cable retention structure **105**. In this example, the cable retention structure **105** is in an open position but without an attached power cable **150**. The cable retention structure **105** includes a hinge **310** that moveably attaches the cable retention structure **105** to the power adapter **100**. The hinge **310** allows the cable retention structure **105** to pivot and fold over into a recessed portion **300** of an exterior side of the adapter unit **115**.

In the closed position, the cable grip **110** fits into the cable grip well **130**. In an embodiment, the cable grip well **130** includes a friction pad **305**. The friction pad **305** is affixed to one or more sides of the cable grip well **130** such that the cable grip **110** may lie against the friction pad **305**. The friction pad **305** helps prevent damage to the cable grip **110** during opening and closing of the cable retention structure **105**.

The cable grip **110** further includes one or more grip dimples **315***a* and **315***b*. The grip dimples **315***a-b* engage a lip or other type of protrusion in a front portion of the cable grip well **130**. The grip dimples **315** help to secure the cable grip **110** within the cable grip well **130**. When the cable grip **110** is moved into the cable grip well **130**, the grip dimples **315** slide under the lip **320**, and then the lip **320** frictionally holds the grip dimples **315** to secure the cable grip **110**. To open the cable retention structure **105**, leverage is applied to the opening structure **200** to push the grip dimples **315** outwards and away from under the lip **320**. The cable grip **110** may then be pushed upwards to open the cable retention structure **105**.

FIG. **4** illustrates a perspective top view of a schematic diagram of an embodiment of the power adapter **100** with the cable retention structure. In this example, the cable retention structure **105** is in an open position but without an attached power cable **150**. A connector head window **400** is cut-out from or formed within the cable retention structure **105**. The connector head window **400** is positioned on the cable retention structure **105** to overlap the connector port **125***a* when the cable retention structure is in the closed position. The connector head window **400** provides access to the connector port **125***a* when the cable retention structure **105** is in a closed position. Thus, the connector port **125***a* may be used in both the open and closed positions of the cable retention structure **105**.

The adapter unit **115** includes another connector port **125***b* positioned on another side of the adapter unit **115** from the first connector port **125***a*. In another embodiment, a plurality of connector ports **125** may be positioned on a single side of the adapter unit **115**.

The top side and the bottom side described herein are opposite exterior sides of the adapter unit **115**. In an embodiment, one or more components illustrated on the bottom side of the power charge mount may be implemented on the top side of the adapter unit. Conversely, one or more components illustrated on the top side of the power charge mount may be implemented on the bottom side of the adapter unit. For example, the cable retention structure may fold over a top side of the adapter unit and fit into the cable grip well that is formed within the top side of the adapter unit.

FIG. **5** illustrates a top view of a schematic diagram of an embodiment of a power adapter housing **500**. The power adapter housing **500** forms the outer case or housing for the power adapter and its internal components. The power adapter housing **500** includes a power plug case **520** and an adapter unit housing **515**. The cable grip well **130** and the recessed portion **300** are formed into the power adapter housing **500**. The lip **320** protrudes into the cable grip well **130**.

FIG. **6**A and FIG. **6**B illustrate perspective views of the top side of the power adapter housing **600** and the bottom side of the power adapter housing **610** respectively. Though the power adapter housing **500** is formed by two parts **600** and **610** in this embodiment, the power adapter housing **500** may be implemented with additional and/or alternative parts as well. In addition, though the top side of the housing **600** is shown as a single part, it may alternatively be formed by a plurality of parts. Similarly, though the bottom side of the housing **610** is shown as a single part, it may alternatively be formed from a plurality of parts.

The top side of the power adapter housing **600** forms connector port receptacles **605**A and **605**B in which the

connector ports **125** may reside. The cable grip well **130** and the recessed portion **300** are formed into the top side of the housing **600**. The lip **320** is formed to protrude into the cable grip well **130**.

The bottom side of the power adapter housing **610** includes an attachment fitting **620** for attaching the cable retention structure **105** to the power adapter **100**. For example, the attachment fitting **620** may include a hinge or connectors for a hinge extending horizontally along the side or on the side or in proximity to a side that houses the connector port receptacle **605**A. Alternatively, the attachment fitting **620** may be configured to include other types of attachment mechanisms, such as a t-hinge, gate hinge, strap hinge, or another type of hinge, ball/socket joint or other movable joint, or other mechanism, that allows the cable retention structure **105** to move with respect to the adapter unit **115**.

Exemplary Embodiments of the Cable Retention Structure

FIG. **7**A and FIG. **7**B illustrate perspective views of the top side of the cable retention structure **700** and the bottom side of the cable retention structure **710** respectively. As shown in FIG. **7**A, the top side of the cable retention structure **700** includes a cable grip **110** with one or more protruding grip dimples **315***a* and **315***b*. The cable retention structure **700** has a connector head window **400** formed therein.

As shown in FIG. **7**B, the cable grip **110** includes u-shaped cable grip walls **715** that form a grip opening **720**. One or more grip protrusions **725***a* and **725***b* extend or project into the grip opening **720**. The grip protrusions **725** assist in applying pressure to clasp the power cable **150** and hold it within the cable grip opening **720**.

The cable retention structure **105** also includes an attachment mechanism **750**. The attachment mechanism **750** attaches or couples to the attachment fitting **620** of the adapter unit **115**. The attachment mechanism **750** may include, e.g. a t-hinge, gate hinge, strap hinge, or another type of hinge, ball/socket joint or other movable joint, or other mechanism, that allows the cable retention structure **105** to move with respect to the adapter unit **115** between an open and closed position.

In an embodiment, an attachment hinge **745** is positioned between the attachment mechanism **750** and a retention panel **735**. The attachment hinge **745** is a living hinge including a thinner flexible portion or folded portion of the material of the cable retention structure. For example, the cable retention structure **105** may bend or fold along the line of the attachment hinge **745**. When the attachment hinge **745** bends, the retention panel **735** folds over a side of the adapter unit **115** into the closed position.

In an embodiment, the connector head window **400** is formed within the retention panel **735** to provide access to a connector port **125** positioned underneath the cable retention structure **105** in the closed position. Thus, the connector port **125** may be used in both the open and closed positions of the cable retention structure **105**.

The cable grip **110** is mounted to a grip component **730**. The grip component **730** provides support for the cable grip **110** and is sized to position the cable grip **110** over the cable grip well **130** when the cable retention structure **105** is in a closed position. The grip component **730** may include an arm, panel or other structure. In the example shown in FIG. **7**, the grip component **730** has tapered sides though in other embodiments, the grip component may have other shapes and sizes.

A grip hinge **740** is formed between the retention panel **735** and the grip component **730**. In an embodiment, the grip hinge **740** is a living hinge including a thinner flexible portion or folded portion of the cable retention material. For example, the material may be thinned or cut to allow the cable retention structure **105** to bend or fold along the line of the flexible portion. The grip hinge **740** bends to position the grip component **730** over the recessed portion **300** of the adapter unit **115**, e.g., when the cable retention structure **105** is in a closed position.

FIG. **8**A illustrates a perspective top view of an embodiment of the cable retention structure **105**. A grip panel head **800** is formed at a thickened portion **810** of the material of the cable retention structure **105** along a grip panel axis **805**. The grip panel head **800** flexes along the grip panel axis **805**. This flexing ability assists the grip panel head **800** to be inserted into and removed from the cable grip well **130**.

FIG. **8**B illustrates a perspective bottom view of an embodiment of the cable retention structure of FIG. **8**A. FIG. **8**B illustrates a bottom view of the grip panel head **800**, and the thickened portion **810** of the material of the cable retention structure **105**. In an embodiment, the material of the cable retention structure **105** includes a polycarbonate material or other thermoplastic polymer type material or other plastic material. In another embodiment, the material of the cable retention structure **105** includes a metal or metal alloy. In yet another embodiment, the material of the cable retention structure **105** includes a rubber type material. In another embodiment, the cable retention structure **105** includes a plurality of materials. For example, components of the attachment mechanism **750** may include a metal or metal alloy material and the retention panel and grip component may include a plastic material. Other materials or combinations of materials may be employed to construct the cable retention structure **105**.

FIG. **9**A illustrates a schematic diagram of an embodiment of an end of the cable retention structure **105**. The cable retention structure **105** is shown along a cross-section of an end of the attachment mechanism **750**. The grip opening **720** is formed by grip wall **720**. The grip wall **720** may include a single formed wall or include a plurality of walls to form an approximately u-shape grip or semi-circle grip opening **720**.

The profile of the grip protrusions **725***a* and **725***b* in the grip opening **720** is illustrated. The grip protrusions **725***a* and **725***b* decrease the opening area such that the grip protrusions **725** hold a power cable within the grip opening **720**. In other aspects, alternative structures may be implemented as the cable grip **110**, such as a latch with a catch and lever, a clasp, etc.

FIG. **9**B illustrates a schematic diagram of an embodiment of another end of the cable retention structure of FIG. **9**A. The cable retention structure **105** is shown along a cross-section of the end of the cable grip **110**. In an embodiment the grip opening **720** is configured to hold a standardized USB cable. For example, the grip opening **720** has a width of approximately 4.00 mm and a depth of approximately 4.70 mm. The grip protrusions **725** protrude within a top portion of the grip opening **720** to decrease the width within that top portion to frictionally hold the power cable within the cable opening **720**. The grip wall **720** may include a single formed wall or include a plurality of walls to form an approximately u-shape grip or semi-circle grip opening **720**.

Though a width of approximately 4.00 mm and a depth of approximately 4.70 mm are described herein, other dimensions may be implemented. For example, in an embodiment, the power adapter **100** includes a plurality of different types of connector ports. In this embodiment, a plurality of cable

retention structures **105** may be implemented with different sized cable grip openings **720** configured to clasp a standardized power cable for such one or more different types of connector ports.

Additional Exemplary Embodiments of the Power Adapter

FIG. **10** illustrates a schematic diagram of another embodiment of a power adapter **1000** with a cable retention structure. In this embodiment, an adapter unit **1005** has a generally octagonal shape. At least one connector port **125** and cable retention structure **105***a* are situated at one side of the octagonal shaped adapter unit **1005**. In another embodiment, a second connector port **125***b* and cable retention structure **105***b* are situated at a second side of the octagonal shaped adapter unit **1005**. In another embodiment, a third connector port **125***c* and cable retention structure **105***c* are situated at a third side of the octagonally shaped adapter unit **1005**.

FIG. **11** illustrates a schematic diagram of another embodiment of a power adapter **1100** with a cable retention structure **105**. In this embodiment, an adapter unit **1105** has a generally pentagonal shape. At least one connector port **125***a* and cable retention structure **105***a* are situated at one side of the pentagonal shaped adapter unit **1105**. In another embodiment, a second connector port **125***b* and cable retention structure **105***b* are situated at a second side of the pentagonal shaped adapter unit **1105**. Other shapes of the adapter unit than those illustrated herein may also be implemented.

FIG. **12** illustrates a schematic diagram of another embodiment of a power adapter **1200** with a cable retention structure. In this embodiment, the adapter unit **1205** includes an electrical outlet plug **1210**. The power plug **120** thus may include an electrical outlet plug **1205** or a cigarette adapter power plug or other type of power plug **120** adapted to connect with a power source.

Exemplary Embodiments of Other Devices with a Cable Retention Structure

In the embodiments described above, the cable retention structure **105** has been described for use with a power adapter. The cable retention structure **105** may also be implemented for use on other types of devices.

FIG. **13** illustrates a schematic diagram of an embodiment of a power strip **1300** with a cable retention structure **105**. The power strip **1300** includes a plurality of electrical outlets **1305***a-n*. The cable retention structure **105** is moveably attached to the power strip **1300** to move between an open position and a closed position. The attachment mechanism may include, e.g. t-hinge, gate hinge, strap hinge, or another type of hinge, ball/socket joint or other movable joint, or other mechanism, that allows the cable retention structure **105** to move with respect to the power strip **1300** between an open and closed position.

In an open position, the cable grip **110** is configured to hold a power cable plugged into one of the electrical outlets **1305**, e.g. electrical outlet **1305***a* in FIG. **13**. The cable grip **110** holds the power cable and helps to resist disconnection of the power cable from the power strip **1300**.

In a closed position, the cable retention structure **105** moves to fold over the top of the power strip **1310** to the side of the power strip **1315**. The cable grip **110** fits into a cable grip well **130** in the side of the power strip **1300** and is frictionally held within the cable grip well **130** to secure the cable retention structure **105** in the closed position. An outlet window **1315** is formed in the cable retention structure **105** and overlaps the electrical outlet **1305***a*. The electrical outlet **1305***a* may thus be used when the cable retention structure **105** is in an open or closed position.

FIG. **14** illustrates a schematic diagram of an embodiment of an electrical device **1400** with a cable retention structure **105**. The electrical device **1400** includes any type of device that includes one or more ports **1405** for communicating data or for connection to a power supply. For example, the electrical device **1400** may include a laptop, a server, a television, a set top box, a mobile phone, smart tablet, modem, vehicle, appliance, etc. The ports **1405***a-n* may include a data port, such as a High Definition Multimedia Interface (HDMI) port, USB port, digital visual interface (DVI) port, video graphic array (VGA), RJ45 port, phone connector ports, or other types of port for communicating data through a data cable to the electrical device **1400**. The ports **1405***a-n* may also include a power port, as described herein, such as a type of USB port, an IEEE 802.3af Power over Ethernet (PoE) port, a MIDI port, or other type of port operable to supply power through a cable or cord to the electrical device **1400**.

The cable retention structure **105** is moveably attached to the electrical device **1400** to move between an open position and a closed position. The attachment mechanism may include, e.g. t-hinge, gate hinge, strap hinge, or another type of hinge, ball/socket joint or other movable joint, or other mechanism, that allows the the cable retention structure **105** to move with respect to the electrical device **1400** between an open and closed position.

In an open position, the cable grip **110** is configured to hold a cable plugged into one of the ports **1405**, e.g. port **1405***a* in FIG. **14**. The cable may be a data cable, power cable, or combination thereof. The cable grip **110** holds the cable and helps to resist disconnection of the cable from the port **1405***a*.

In a closed position, the cable retention structure **105** moves to fold over a side of the electrical device **1400**. The cable grip **110** fits into a cable grip well (not shown in FIG. **14**) in the side of the electrical device **1400** and is frictionally held within the cable grip well to secure the cable retention structure **105** in the closed position. A port window **1315** is formed in the cable retention structure **105** and overlaps the port **1405***a*. The port **1405***a* may thus be used when the cable retention structure **105** is in an open or closed position.

Additional Exemplary Embodiments of the Cable Retention Structure

The cable retention structure **105** described herein may have one or more implementations or alternative structures.

FIG. **15** illustrates a schematic diagram of another embodiment of a cable retention structure **1500**. The cable retention structure **1500** includes a retention panel **1505** and an attachment mechanism **1515** to moveably attach the cable retention structure **1500** to a device. An attachment hinge **1520** is positioned between the attachment mechanism **1515** and the retention panel **1505**. The attachment hinge **1520** is a living hinge including a thinner flexible portion or folded portion of the material of the cable retention structure **1500**. For example, the cable retention structure **1500** may bend or fold along the line of the attachment hinge **1520**. When the attachment hinge **1520** bends, the retention panel **1505** folds over a side of a device to a closed position. In an embodiment, a port window **1510** is formed within the retention panel **1505**. In the closed position, the port window **1510** overlaps the connector port **105**. Thus, the connector port **125** may be used in both the open and closed positions of the cable retention structure **105**.

In this embodiment, a cable grip **1525** is mounted to the retention panel **1505**. The retention panel **1505** is sized to position the cable grip **1525** over a cable grip well when the

cable retention structure **1500** is in a closed position. The retention panel **1505** may include an arm, panel or other structural support.

FIG. **16** illustrates a schematic diagram of another embodiment of a cable retention structure **1600**. The cable retention structure **1600** includes a retention panel **1605** and an attachment mechanism **1615** that moveably attaches the cable retention structure **1600** to a device. An attachment hinge **1620** is positioned between the attachment mechanism **1615** and the retention panel **1605**. In an embodiment, a port window **1610** is formed within the retention panel **1605** to provide access to a connector port positioned underneath the cable retention structure **1600** in the closed position. Thus, the connector port may be used in both the open and closed positions of the cable retention structure **1600**.

The cable retention structure **1600** also includes a cable grip **1630** mounted to a grip component **1625**. The grip component **1625** provides support for the cable grip **1630** and is sized to position the cable grip **1630** over a cable grip well when the cable retention structure **1600** is in a closed position. The grip component **1625** may include an arm, panel or other structure. In the example shown in FIG. **16**, the grip component **1625** has a rectangular shape though in other embodiments, the grip component **1625** may have other shapes and sizes.

In one or more embodiments described herein, a cable retention structure is coupled to a device to move between an open position and a closed position. In an open position, a cable grip part of the cable retention structure is configured to firmly clasp a cable. This helps to prevent the disconnection of a connector of the cable from a port of the device. In a closed position, the cable retention structure moves to fold over a side of the device. The cable grip part of the cable retention structure fits into a cable grip well in the side of the device and is frictionally held within the cable grip well to secure the cable retention structure in the closed position.

In the foregoing specification, certain representative aspects of the invention have been described with reference to specific examples. Various modifications and changes may be made, however, without departing from the scope of the present invention as set forth in the claims. The specification and figures are illustrative, rather than restrictive, and modifications are intended to be included within the scope of the present invention. Accordingly, the scope of the invention should be determined by the claims and their legal equivalents rather than by merely the examples described. For example, the components and/or elements recited in any apparatus claims may be assembled or otherwise operationally configured in a variety of permutations and are accordingly not limited to the specific configuration recited in the claims.

Furthermore, certain benefits, other advantages and solutions to problems have been described above with regard to particular embodiments; however, any benefit, advantage, solution to a problem, or any element that may cause any particular benefit, advantage, or solution to occur or to become more pronounced are not to be construed as critical, required, or essential features or components of any or all the claims.

As used herein, the terms "comprise," "comprises," "comprising," "having," "including," "includes" or any variation thereof, are intended to reference a nonexclusive inclusion, such that a process, method, article, composition or apparatus that comprises a list of elements does not include only those elements recited, but may also include other elements not expressly listed or inherent to such process, method, article, composition, or apparatus. Other combinations and/or modifications of the above-described structures, arrangements, applications, proportions, elements, materials, or components used in the practice of the present invention, in addition to those not specifically recited, may be varied or otherwise particularly adapted to specific environments, manufacturing specifications, design parameters, or other operating requirements without departing from the general principles of the same.

Moreover, reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is intended to be construed under the provisions of 35 U.S.C. §112(f), unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

The invention claimed is:

1. A power adapter, comprising:

an adapter unit, including:

a power plug mounted to a first side of the adapter unit; and

a connector port in a second side of the adapter unit, wherein the connector port is configured for coupling to a connector head of a power cable;

a cable retention structure attached to the adapter unit, wherein the cable retention structure includes a cable grip configured to hold the power cable;

an attachment mechanism that moveably attaches the cable retention structure to the adapter unit, wherein the cable retention structure is operable to move between an open position and a closed position; and

wherein an opening is formed within the cable retention structure, wherein the opening is positioned to overlap the connector port when the cable retention structure is in the closed position.

2. The power adapter of claim **1**, wherein the cable grip comprises:

at least one grip wall that forms a generally u-shaped grip opening; and

at least one grip protrusion that protrudes from the grip wall, wherein the at least one grip protrusion is configured for frictionally clasping the power cable.

3. The power adapter of claim **2**, wherein the at least one grip protrusion is configured for frictionally clasping the power cable when the cable retention structure is in the open position.

4. A power adapter, comprising:

an adapter unit, including:

a power plug mounted to a first side of the adapter unit; and

a connector port in a second side of the adapter unit, wherein the connector port is configured for coupling to a connector head of a power cable;

a cable retention structure attached to the adapter unit, wherein the cable retention structure includes a cable grip configured to hold the power cable, wherein the cable retention structure further comprises:

a grip component coupled to the cable grip; and

a grip hinge coupled between the grip component and the attachment mechanism, wherein the grip hinge is configured to fold the grip component over an exterior side of the adapter unit, wherein the grip hinge is configured to fold the grip component across the exterior side of the adapter unit when the cable retention structure is in the closed position; and

wherein the adapter unit further comprises a cable grip well that is formed within the exterior side of the adapter unit, wherein the cable grip well is configured to hold the cable grip when the cable retention structure is in the closed position.

5. The power adapter of claim **4**, wherein the power plug includes at least one of: a cigarette lighter power plug or an electrical outlet plug.

6. A device, comprising:

an adapter unit;

a connector port housed in the adapter unit, wherein the connector port is configured for coupling to a connector of a cable; and

a cable retention structure attached to the adapter unit, wherein the cable retention structure includes:

a cable grip mounted on the cable retention structure, wherein the cable grip is configured to hold the cable;

an attachment mechanism that moveably attaches the cable retention structure to the adapter unit, wherein the cable retention structure is operable to move between an open position and a closed position; and

wherein a window is formed within the cable retention structure and positioned to overlap the connector port when the cable retention structure is moved to the closed position.

7. The device of claim **6**, wherein the adapter unit further comprises:

a power plug mounted to the adapter unit.

8. The device of claim **6**, wherein the cable grip comprises:

at least one grip wall that forms a u-shaped grip opening; and

at least one grip protrusion that protrudes from the grip wall, wherein the at least one grip protrusion is configured for frictionally holding the cable.

9. The device of claim **8**, wherein the at least one grip protrusion is configured for frictionally holding the cable when the cable retention structure is in the open position.

10. The device of claim **6**, wherein the cable retention structure further comprises:

a grip component coupled to the cable grip; and

a grip hinge coupled between the grip component and the attachment mechanism, wherein the grip hinge is configured to fold the grip component across an exterior side of the adapter unit when the cable retention structure is in the closed position.

11. The device of claim **6**, wherein the connector port housed in the adapter unit comprises at least one of: a Universal Serial Bus (USB) port, a mini-USB port, a micro-USB port, or an IEEE 802.3af Power over Ethernet (PoE) port.

12. A device, comprising:

a port housed in the device, wherein the port is configured for coupling to a connector of a cable;

a cable retention structure attached to the device, wherein the cable retention structure is configured to grip the cable;

an attachment mechanism that moveably attaches the cable retention structure to the device, wherein the cable retention structure is operable to move between an open position and a closed position;

a recessed portion formed in an exterior side of the device; and

a grip panel hinge coupled between the grip component and the attachment mechanism, wherein the grip hinge is configured to fold the grip component at least partially within the recessed portion formed in the exterior side of the device when the cable retention structure is in the closed position.

13. The device of claim **12**, wherein the cable retention structure comprises:

a cable grip mounted on the cable retention structure, wherein the cable grip is configured to clasp the cable.

14. The device of claim **13**, wherein the cable grip comprises:

at least one grip wall that forms a grip opening; and

at least one grip protrusion that protrudes from the grip wall, wherein the at least one grip protrusion is configured for frictionally clasping the cable.

15. The device of claim **12**, wherein the cable retention structure further comprises:

a cable grip well that is formed within the exterior side of the adapter unit, wherein the cable grip well is configured to hold the cable grip when the cable retention structure is in the closed position.

16. The device of claim **12**, wherein the cable retention structure further comprises:

an attachment mechanism that moveably attaches the cable retention structure to the adapter unit, wherein the cable retention structure is operable to move between an open position and a closed position; and

wherein an opening formed within the cable retention structure is positioned to overlap the connector port when the cable retention structure is in the closed position.

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